Decision Rationale

Total Maximum Daily Load of
Fecal Coliform for Big Otter River Watershed

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Load (TMDL) of Fecal Coliform for the Big Otter River Watershed submitted for final Agency review on January 04, 2001 Our rationale is based on the TMDL submittal document to determine if the TMDL meets the following 8 regulatory conditions pursuant to 40 CFR §130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. The TMDLs have been subject to public participation.
8. There is reasonable assurance that the TMDLs can be met.

II. Background

Located in Bedford and Campbell Counties, the overall Big Otter watershed is approximately 388 square miles. The TMDL was developed for the Big Otter River and four of its tributaries. Sheep Creek, Elk Creek, Machine Creek, and the Little Otter River were the four impaired tributaries of the Big Otter river. The TMDL addresses 14.75 stream miles of the Big Otter River from 0.5 miles downstream of the Route 682 Bridge to its confluence with the Roanoke River. The impaired segment of Sheep Creek is 7.33 miles and runs from route 614 to its confluence with Stony Creek. The impaired segment of Elk Creek is 7.48 miles and runs from the Route 643 Bridge to its confluence with the Big Otter. The listed segment of Machine Creek is 20.00 miles and flows from the intersection of Routes 24 & 732 to its confluence with the Little Otter River. 27.22 miles of the Little Otter River is listed as well, stretching from Route 680, to two miles upstream of the Route 460 Bridge. Forest is the major land use in the watershed and makes up roughly 59.0% of the land (this includes three unlisted subwatersheds of the Big Otter (North Otter Creek, Flat Creek, and Buffalo Creek).

In response to Section 303 (d) of the Clean Water Act (CWA), the Virginia Department of Environmental Quality (VADEQ) listed segments of the Big Otter River, Little Otter River, Machine Creek, Sheep Creek, and Elk Creek as being impaired by elevated levels of fecal coliform. These streams were listed for violations of Virginia's fecal coliform bacteria standard for primary contact. Fecal Coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presences of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the States to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli (and enterococci) and the incidence of gastrointestinal illness. The Commonwealth is pursuing changing the standard from fecal coliform to e-coli.

Virginia designates all of its waters for primary contact, therefore all waters must meet the current fecal standard for primary contact. Virginia's standard is to apply to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs it was discovered that natural conditions (wildlife contributions to the streams) were causing violations of the standard during low flows. Thus many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the stream. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to implementation discussion below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. The first phase of the implementation will reduce all sources of fecal coliform to the stream other than wildlife. In phase 2, which can occur concurrently to phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. During phase 2, the Commonwealth has indicated that it will evaluate the following items in relation to the standard. 1) The possibility of placing a minimum flow requirement upon the bacteriological standard. As a result, the standard may not apply to flows below the minimum (possibly 7Q10). This application of the standard is applied in many States. 2) May develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of that UAA, it is possible that these streams could be designated primary contact infrequent bathing. 3) The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of phase 1 of the implementation plan the Commonwealth will monitor to determine if the wildlife reductions are actually necessary, as the violation rate associated with the wildlife loading may be smaller than the percent error of the model. In phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of phases 1 and 2 further work and reductions will be warranted.

The Big Otter River identified as watershed VAW-L28R, was given a high priority for TMDL development. Section 303 (d) of the Clean Water Act and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the State where technology-based and other controls do not provide for the attainment of Water Quality Standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to the Big Otter River and its impaired tributaries (Elk Creek, Machine Creek, Little Otter River, and Sheep Creek), as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform which is reaching the stream from land based sources. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by both point and nonpoint sources. Tables 1a-f document the annual fecal coliform loading (cfu/year).

Table #1a summarizes the specific elements of the TMDL for Sheep Creek.

Watershed	Waste Load Allocation (cfu/yr)	Load Allocation (cfu/yr)	Margin of Safety [a] (cfu/yr)	TMDL (cfu/yr)
Sheep Creek	$\leq 0.1 \times 10^{12}$	1695.2×10^{12}	89.2×10^{12}	$1,784.4 \times 10^{12}$

[a] Five percent of TMDL

Table #1b summarizes the specific elements of the TMDL for Elk Creek

Watershed	Waste Load Allocation (cfu/yr)	Load Allocation (cfu/yr)	Margin of Safety [a] (cfu/yr)	TMDL (cfu/yr)
Elk Creek	$< 0.1 \times 10^{12}$	2421.6×10^{12}	127.5×10^{12}	2549.1×10^{12}

[a] Five Percent of TMDL

Table #1c summarizes the specific elements of the TMDL for Machine Creek

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.
[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

Watershed	Waste Load Allocation (cfu/yr)	Load Allocation (cfu/yr)	Margin of Safety [a] (cfu/yr)	TMDL (cfu/yr)
Machine Creek	0.12×10^{12}	414.6×10^{12}	21.8×10^{12}	436.5×10^{12}

a Five percent of the TMDL

Table #1d summarizes the specific elements of the TMDL for Little Otter

Watershed	Waste Load Allocation (cfu/yr)	Load Allocation (cfu/yr)	Margin of Safety [a] (cfu/yr)	TMDL (cfu/yr)
Little Otter	5.65×10^{12}	$1,377.7 \times 10^{12}$	72.8×10^{12}	1456.15×10^{12}

a Five percent of the TMDL

Table #1e summarizes the specific elements of the TMDL for the impaired segment of the Big Otter River

Watershed	Waste Load (cfu/yr)	Load Allocation [a] (cfu/yr)	Margin of Safety [b] (cfu/yr)	TMDL (cfu/yr)
Big Otter	$< 0.1 \times 10^{12}$	$1,138.1 \times 10^{12}$	59.9×10^{12}	$1,198.0 \times 10^{12}$

a Includes upstream inflow from two unlisted tributaries (Buffalo Creek and Flat Creek).
b Five percent of the TMDL

The lower Big Otter River was modeled as receiving a fecal coliform load from all of its subwatersheds, as well as the loading from the impaired segment (lower Big Otter River) itself. The loads from both the impaired and unimpaired watersheds were modeled as if they were a point source discharging a load to this impaired segment. Therefore, the TMDL report has a WLA and LA for the Big Otter River as a stand alone segment. However, in reality the Big Otter was modeled as though it was receiving a load from all of the impaired and unimpaired watersheds. Therefore, EPA believes that the TMDL equation for the lower Big Otter should incorporate all of the loads going to the impaired segment. Table 1f documents the total loading to the lower Big Otter.

Table #1f summarizes the loading to the Lower Big Otter from the segment itself and all other segments.

Watershed	Waste Load (cfu/yr)	Load Allocation (cfu/yr)	Margin of Safety (cfu/yr)	TMDL (cfu/yr)
Big Otter	$8.74 X 10^{12}$	$12,838.7 \times 10^{12}$	371.2×10^{12}	$12,847.4 \times 10^{12}$

The United States Fish and Wildlife Service has been provided with copies of these TMDLs.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the 8 basic requirements for establishing a fecal coliform TMDL for the Big Otter River. EPA therefore approves these TMDLs . Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources have caused violations of the water quality standards and designated uses on the Big Otter River, Sheep Creek, Elk Creek, Machine Creek, and the Little Otter River. The water quality criterion for fecal coliform is a geometric mean 200 cfu (colony forming units)/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30-day period are required for the geometric mean standard. Due to the number of streams involved and limitations in financial and personnel resources, the Commonwealth is only able to sample most streams once a month. Therefore, these streams were listed for violations of the instantaneous standard. Sampling on these streams will continue to determine if the load reductions called for in the TMDL allow the streams to attain standards. The sampling methodology will change to the geometric mean (two or more samples per month), once a ten percent (or less) violation rate has been observed.

The same sampling methodology will be employed when the new bacteriological (e-coli and enterococci) standards are adopted. However, the concentration of e-coli and enterococci will differ from the concentration of fecal coliform in the current standards. EPA's recommended steady-state geometric mean values for these water quality criteria for bacteria are 33 enterococci per 100 ml and 126 e-coli per 100 ml for fresh water[3]. A state might adopt these values as its water quality standard(s) or such other values as it can demonstrate they are protective of the use for which a particular waterbody is designated.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to the Big Otter River, Sheep Creek, Machine Creek, Elk Creek, and Little Otter River will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Information is attained from a wide array of sources on the farm practices in the area (land application rates of manure), the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc. This information was put into the model. The model then combines all the data to determine the hydrology and water quality of the stream.

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[3]USEPA. 2000. *Implementation Guidance for Ambient Water Quality for Bacteria – 1986.* EPA-823-D-00-001. U.S. Environmental Protection Agency, Office of Water.

The hydrology component of the model for all the Big Otter TMDLs was developed using United States Geologic Survey (USGS) gages #02061000 and #02061500 on the upper and lower Big Otter River respectively. Gage #02061000 had flow data from October of 1943 to September of 1960, while gage#02061500 had flow data from April of 1937 to September of 1999. A regression relationship was developed in order to derive flow in the upper watershed from the data in the lower watershed (gage# 02061500). The regression analysis was run for two separate periods Oct. 1, 1943 - Sep.30, 1950 and Oct. 1, 1950 - Sep.30, 1960. The regression was used to determine if there were any changes in the response of either the upper or lower Big Otter during the 1943 -1960 study period. There was a strong correlation between the two stations. The hydrology developed on the Big Otter was transferred to the other watersheds, as there were no stream gages on the other stream segments.

Weather data is one of the mechanisms that drives the hydrology, as precipitation provides flow to the stream. The weather data for this model was obtained from several weather stations and precipitation gages in the watershed. Precipitation gages at the Lynchburg Municipal Airport and Altavista provided most of the weather data.

The hydrology was calibrated to gage #02061500 using data from Jan. 01, 1990 through May 31, 1995. Data from Jan. 01, 1996 through Dec. 31, 1998 was used to validate the model. Additional validation runs were developed on the estimated flow data from USGS station 02061000 (this station only had data until 1960), this measured the transferability of the model. The observed and simulated data closely matched each other for the initial calibration period for gage #02061500. The percent error for the validation runs was well within the accepted range.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for the Big Otter River, Little Otter River, Elk Creek, Machine Creek, and Sheep Creek.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

<u>Total Allowable Loads</u>

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based, precipitation driven nonpoint source areas (commercial land, cropland, forest, high density residential, pasture, rural residential), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife, straight pipes, and failed septic systems), and point sources. Activities such as the application of manure, fertilizer, and the deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Tables 3a-e of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

<u>Waste Load Allocations</u>

Virginia has stated that there are fourteen point sources discharging to the study area. Seven of the fourteen point sources are actually discharging to an impaired watershed. Four of the fourteen point sources are not permitted to discharge fecal coliform and would not have this pollutant associated with their waste stream. EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any NPDES permit that is inconsistent with the WLAs established for that point source.

Table 2 - Lists all of the Point Sources in the Big Otter Watershed.

Facility	Permit Number	Watershed
Gunnoe Sausage Company	VA0001449	Elk Creek*
Otter River Elementary School	VA0020851	Elk Creek*
Thraxton Elementary School[B]	VA0020869	Little Otter River
Liberty High School	VA0020796	Little Otter River
Dillons Trailer Park	VA0087840	Little Otter River
City of Bedford STP	VA0022390	Little Otter River
City of Bedford WTP [A]	VA0001503	Little Otter River
New London Academy	VA0020826	Buffalo Creek**
Alum Springs Shopping Center	VA0078999	Buffalo Creek**
Hill City Swim Club [A]	VA0089311	Buffalo Creek**
Blue Ridge Stone Company[A]	VA0050628	Flat Creek**
Briarwood Village STP	VA0031194	Flat Creek**
Body Camp Elementary School	VA0020818	Machine Creek
Otter River WTP	VA0078646	lower Big Otter

A -Permit does not contain a fecal coliform limit.
* -Not discharging to the impaired segment.
**-Stream segment is not impaired.

B - After the development of the TMDL it was determined that facility did not discharge to the Little Otter River.

All of the point sources which are permitted to discharge fecal coliform (other than Gunnoe Sausage Company) are required to chlorinate. All of these facilities (other than Gunnoe) are permitted to discharge fecal coliform at a rate of 200 cfu/ 100 ml. Gunnoe Sausage is permitted to discharge an average fecal concentration of 200 cfu/100 ml and a maximum concentration of 400 cfu/100 ml. The concentration of fecal coliform in the effluent of facilities which are required chlorinate is most likely far lower than their permitted concentration of 200 cfu/ 100 ml. Proper chlorination often reduces the concentration of fecal coliform to less than 15 cfu/ 100 ml. Many of these dischargers were modeled as not contributing a fecal coliform load to the impaired segments due to chlorination in the existing condition runs. However, for the allocation scenarios, each facility was modeled as discharging at its permitted limit. Model runs demonstrate that even if the loading from these sources was zeroed out, wildlife contributions would still cause a violation of the standard.

Gunnoe Sausage Company and Otter River Elementary School discharge downstream of the impaired segment of Elk Creek. Based on data obtained from the permits a total loading for each of these sources was determined. Point sources represented a small portion of the total loading even if they discharge at their permitted levels (which most are not as they are required to chlorinate). There were no reductions needed from point sources.

The fecal coliform loading from Gunnoe Sausage Company and River Otter Elementary School did not effect the impaired segment of Elk Creek (since their discharge did not flow into this segment). However, the loads from both of these facilities were modeled to the lower Big Otter River. Therefore, their WLA is associated with the lower Big Otter not Elk Creek. Briarwood Village STP, New London Academy, and Alum Springs Shopping Centers all discharged their effluent to an unimpaired segment, however, their discharge was modeled as going to the lower Big Otter as well. Therefore, their WLA is associated with the lower Big Otter River. All of these dischargers were given a WLA equivalent to their permit limits. Table 2b lists the WLAs associated with each point source in cfu/year.

Table 2b - Waste Load Allocations (WLAs) for each point source.

Facility	Watershed	WLA (cfu/yr)
Thraxton Elementary School	Little Otter River	N/A
Liberty High School	Little Otter River	6.83×10^{10}
Dillons Trailer Park	Little Otter River	4.99×10^{10}
City of Bedford STP	Little Otter River	5.53×10^{12}
City of Bedford WTP	Little Otter River	N/A

Gunnoe Sausage Company	Elk Creek	1.07×10^{12}
Otter River Elementary School	Elk Creek	1.24×10^{11}
New London Academy	Buffalo Creek	1.11×10^{10}
Alum Springs Shopping Center	Buffalo Creek	1.10×10^{12}
Hill City Swim Club	Buffalo Creek	N/A
Blue Ridge Stone Company	Flat Creek	N/A
Briarwood Village STP	Flat Creek	6.64×10^{11}
Body Camp Elementary School	Machine Creek	1.24×10^{11}
Otter River WTP	Big Otter	N/A

N/A - There are no fecal coliform limits in the permit.

The waste load allocation for Little Otter River is the sum of the WLAs from Liberty High School, Dillon's Trailer Park, and City of Bedford STP. The waste load allocation for Machine Creek is equal to the waste load allocation for Body Camp Elementary School. The waste load allocation for the lower Big Otter is equal to the summation of all of the waste load allocations listed in Table 2b.

Load Allocations

According to federal regulations at 40 CFR 130.2 (g), load allocations are best estimates of the loading, which may range form reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VA DEQ used the HSPF model to represent the Big Otter River Watershed. The HSPF model is a comprehensive modeling system for simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants and toxicant[4]. More specifically HSPF uses precipitation data for continuous and storm event simulations to determine total fecal loading to the Big Otter River Watershed from all land sources. The total land loading of fecal coliform is the result of the application of manure, direct deposition from cattle and wildlife (geese, deer, muskrat, racoon, etc.) to the land, fecal coliform production from dogs, and application of sludge.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-

[4] Supra, footnote 2.

stream, straight pipes, wildlife in-stream, and failed septic systems. These sources are not dependent on a transport mechanism to reach a surface waterbody and therefore can impact water quality during low and high flow events.

Tables 3a-e illustrate the load allocations for all nonpoint sources of fecal coliform.

Table 3a -Load allocation for all nonpoint sources of fecal coliform for Sheep Creek

Source	Existing Load $(\times 10^{12})$ (cfu/yr)	Allocated Load $(\times 10^{12})$ (cfu/yr)	Percent Reduction
Commercial Land	<0.01	<0.01	0
Cropland	1.07	0.43	60
Forest	35.68	35.68	0
High Density Residential	0.03	0.03	0
Pasture	4,112.79	1,645.12	60
Rural Residential	9.99	9.99	0
Cattle In-Stream	96.3	0.0	100
Wildlife In-Stream	19.6	3.9	80
Straight Pipes	8.9	0.0	100
Total	4,284.36	1,695.15	60

Table 3b - Load allocation for the land application of fecal coliform for Elk Creek

Source	Existing Load $(\times 10^{12})$ (cfu/yr)	Allocated Load $(\times 10^{12})$ (cfu/yr)	Percent Reduction
Commercial Land	0.01	0.01	0
Cropland	0.06	0.02	60
Forest	19.19	19.19	0
High Density Residential	0.39	0.39	0

Pasture	5,697.95	2,279.18	60
Rural Residential	106.71	106.71	0
Cattle In-Stream	138.8	4.2	97
Wildlife In-Stream	39.7	11.9	70
Straight Pipes	1.8	0.0	100
Total	6,004.61	2,421.6	60

Table 3c - Load allocation for the land application of fecal coliform for Machine Creek

Source	Existing Load $(\times 10^{12})$ (cfu/yr)	Allocated Load $(\times 10^{12})$ (cfu/yr)	Percent Reduction
Commercial Land	<0.01	<0.01	0
Cropland	0.13	0.05	60
Forest	1.49	1.49	0
High Density Residential	0.01	0.01	0
Pasture	996.32	398.53	60
Rural Residential	3.30	3.30	0
Cattle In-Stream	126.6	0.0	100
Wildlife In-Stream	31.9	11.2	65
Straight Pipes	0.0	0.0	0
Total	1,159.76	414.59	64

Table 3d - Load allocation for the land application of fecal coliform for Little Otter River

Source	Existing Load $(\times 10^{12})$ (cfu/yr)	Allocated Load $(\times 10^{12})$ (cfu/yr)	Percent Reduction
Commercial Land	0.01	0.01	0
Cropland	0.11	0.04	60
Forest	8.14	8.14	0

High Density Residential	78.11	78.11	0
Pasture	3,136.00	1,254.4	60
Rural Residential	24.87	24.87	0
Cattle In-Stream	130.4	0	100
Wildlife In-Stream	41.00	12.30	70
Straight Pipes	1.8	0.0	100
Total	3,420.44	1,377.87	60

Table 3e - Load allocation for the land application of fecal coliform for Big Otter River

Source	Existing Load $(\times 10^{12})$ (cfu/yr)	Allocated Load $(\times 10^{12})$ (cfu/yr)	Percent Reduction
Commercial Land	0.01	0.01	0
Cropland	0.17	0.08	50
Forest	86.26	86.26	0
High Density Residential	0.55	0.55	0
Pasture	1,998.26	999.13	50
Rural Residential	31.54	31.54	0
Cattle In-Stream	96.1	0.0	100
Wildlife In-Stream	40.9	20.5	50
Straight Pipes	1.8	0.0	100
Total	2,255.6	1,138.1	50

Please note that table 3e identifies the load allocations from sources within the impaired segment of the lower Big Otter only. In order to determine the full load allocation the total loading from table 3e must be combined with the loading from each impaired segment plus the loading from Buffalo and Flat Creek (and respectively) as well.

The point source loading from the Buffalo Creek, Elk Creek, and Flat Creek must be subtracted from this total loading as they have been incorporated into the waste load allocation. The total loading is documented in table 1f.

3) The TMDL considers the impacts of background pollution.

[illegible] $\times 10^{12}$

A background concentration was set for all land segments by adding an additional 10% of the total wildlife load to each land segment and the stream itself.

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the Big Otter River Watershed is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[5]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence but when modeled to, insure that water quality standards will be met for the remainder of conditions. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable “worst-case” scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The sources of bacteria for these stream segments were mixtures of dry and wet weather driven sources. Therefore, the critical condition for the Big Otter River Watershed was represented as a typical hydrologic year. However, the most stringent reductions were needed to insure that water quality standards were met during extreme low flow conditions. During these low flow conditions, only wastes directly deposited to the stream, reach the stream. The greatest violations were recorded in the summer months.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs during the colder period of winter and in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis will effectively consider seasonal environmental variations.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the wasteload allocation, load allocation, or TMDL.

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[5]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

Virginia includes an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% margin of safety.

7) The TMDLs have been subject to public participation.

This TMDL was subject to a number of public and private meetings. Three public meetings were held to discuss the TMDL and TMDL process. The meetings were held on March 16, 2000, May 23, 2000, and August 2, 2000 and were intended to address questions and concerns regarding outreach the TMDL and TMDL process.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the Clean Water Act, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it may be appropriate to modify its current standards to address the problems associated with wildlife loadings. It is believed that either because of the violation rate associated with the wildlife loadings and/or because of any modifications that may be made, that phase 1 of the implementation process will allow the Big Otter River Watershed to attain standards. The Commonwealth is investigating changing the use of these waters, adding a minimum flow component, or having a natural condition amendment added to their standards.